Maxim DirectDrive® II耳机放大器，有效延长便携设备的音频播放时间

Maxim的第二代DirectDrive技术可构建效率极高的无干扰H类架构。

新型放大器在提供高质量音频输出的同时有效延长音频播放时间
[高分辨率图片]

SUNNYVALE，CA，2010年4月29日。Maxim Integrated Products (NASDAQ: MXIM)推出双模H类耳机放大器**MAX97200**，设计用于电池供电的便携设备。该款放大器采用Maxim专有的DirectDrive II技术，可构建效率极高的H类架构。MAX97200的效率几乎是AB类放大器的2倍，可有效延长音频播放时间。此外，器件的无干扰开关架构和无咔嗒/噼噗声性能，能够为终端用户提供更为丰富的音频体验。该款IC的大小只有2mm²，是目前市场上尺寸最小的立体声耳机放大器。MAX97200非常适合蜂窝电话、便携式媒体播放器(PMP)、笔记本电脑及其它电池供电的音频应用。

面临的挑战：提高放大器效率

当今的便携式消费类电子产品支持多种多媒体功能，但这同时也会影响电池使用寿命。该问题在目前的每个新设计中都愈加突出，因为设计人员正根据需求不断地将照相机模块、HD视频、网络浏览及其它多种功能集成到新一代设备中。为了保持这种“功能扩展”能力，系统设计人员必须找到新的途径以延长电池使用寿命。

选择适当的放大器对节省电能至关重要。比如AB类放大器就以效率低而著称，无论音频信号电平大小如何，都使用最大的电源电压供电。这种方式导致在正常收听水平下(向16Ω负载提供2mW至5mW功率)效率只有13%至15%。

相反，H类放大器(在欧洲称为G类)能够根据输出信号的幅度在多个内部产生的电源之间进行切换。通过快速选择电源电压，H类放大器在提高效率的同时能够将输出级的动态失真降至最低。

与AB类放大器相比，MAX97200的效率可提高97%。在2mW至5mW输出功率范围内，MAX97200的效率可达20%至29%。图1给出了Maxim H类放大器与AB类放大器(MAX9725)的效率对比曲线。

DirectDrive II技术可构建功耗最低的H类架构

Maxim的DirectDrive II技术采用内部双模电荷泵，从外部1.8V稳压源产生±PVIN和±PVIN/2电源。MAX97200在输出信号幅度较低时采用±PVIN/2电源供电，只有当负载需要较大输出功率时才切换至±1.8V电源。由于绝大多数音频信号的幅度较低，MAX97200的功耗与传统±0.9V DirectDrive放大器的功耗相当。

为进一步节省电能，器件在关断模式下的电流损耗低于1µA，正常工作时的电流仅为1.15mA (典型值)。

无干扰音频性能

H类架构面临的一个挑战是需要在输出信号变化至较大值之前切换电源，否则音频输出会出现明显的削波效应，产生动态失真。

Maxim的H类技术具有独特的跟踪功能，可预估音频信号的电平变化，从而实现电源的无缝调节。这种方式可确保信号的连续性，不会出现同类竞争放大器常见的干扰信号。图2对比了MAX97200的无失真特性与同类G类放大器的削波失真。

MAX97200在进入和退出关断模式时具有业内领先的咔嗒/噼噗声性能，这是由于器件具有极低的输出失调电压。由于DirectDrive II架构在单电源供电时产生以地为参考的输出，从而省去了放大器输出与耳机负载之间通常所需的大尺寸隔直流电容。该特性确保不会产生令人厌烦的咔嗒/噼噗声，从而为终端用户提供更好的听觉体验。

此外，MAX97200具有较高的信噪比(SNR = 105dB)，确保系统的高保真音效。器件的输出噪声仅为5.6µV，改善了整体的音频噪底指标，在没有信号时不会产生嘶嘶声。

针对小尺寸封装进行优化

MAX97200是市场上尺寸最小的高效耳机放大器，采用微型(1.27mm x 1.65mm)、12焊球晶片级封装(WLP)，比最接近的竞争产品缩小25%。由于MAX97200无需电感，其整体方案尺寸比竞争器件降低30% (图3)。

更多信息

MAX97200采用1.8V单电源供电，能够为32Ω负载提供34mW输出功率。器件工作在-40°C至+85°C扩展级温度范围。芯片起价$0.45 (1000片起，美国离岸价)。提供评估板以加快设计进程，更多信息请访问china.maxim-ic.com/Class-H-Amp。

Maxim Integrated Products是一家设计、生产、销售高性能半导体产品的上市公司。公司在超过25年的发展进程中不断创新，始终致力于为客户提供具有高产品附加值的模拟和混合信号设计方案。迄今为止，公司的产品总数超过6300种，广泛应用于工业、通信、消费类电子以及计算处理等领域。

Maxim在2009财政年度收入超过16亿美元。作为财富杂志1000强公司，Maxim位于Nasdaq 100、Russell 1000和MSCI USA指数的公司列表中。欲获取更多信息，请访问china.maxim-ic.com。

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客户服务： 86 10 62115199

附加说明： MAX97200
- 快速浏览数据资料
- 数据资料全文 (PDF)

高分辨率图片： - 下载RGB文件 (TIF.ZIP) (JPG)
- 下载CMYK文件 (TIF.ZIP) (JPG.ZIP) (PDF)

19-4981; Rev 1; 3/10

EVALUATION KIT AVAILABLE

Low-Power, Low-Offset, Dual Mode, Class H DirectDrive Headphone Amplifier

MAX97200

General Description

The MAX97200 is a 45mW Class H headphone amplifier that runs from a single low 1.8V supply voltage and employs Maxim's second-generation DirectDrive® technology.

The MAX97200 features a Dual Mode™ internal charge pump to generate the power rails for the amplifier. The charge-pump output can be ±PVIN/2 or ±PVIN depending on the amplitude of the output signal. When the output voltage is low, the power-supply voltage is ±PVIN/2. When the output signal demands larger output voltage, the charge pump switches modes so that a greater power-supply voltage is realized and more output power can be delivered to the load.

Second-generation DirectDrive technology improves power consumption when compared to first-generation DirectDrive amplifiers. The MAX97200 can be powered from a regulated 1.8V and have similar power consumption to a traditional DirectDrive amplifier that is powered from 0.9V.

Maxim's patented DirectDrive architecture uses an inverting charge pump to derive a negative voltage supply. The headphone amplifier is powered between the positive supply and the generated negative rail. This scheme allows the audio output signal to be biased about ground, eliminating the need for large DC-blocking capacitors between the amplifier output and the headphone load.

Low-output offset voltage provides very good click-and-pop performance both into and out of shutdown. High signal-to-noise ratio maintains system fidelity.

The MAX97200 is available in a tiny, 12-bump wafer level packaging (WLP 1.27mm x 1.65mm) with a small, 0.4mm lead pitch and specified over the -40°C to +85°C extended temperature range.

Applications

Cellular Phones

Smartphones

MP3 Players

VoIP Phones

DirectDrive is a registered trademark of Maxim Integrated Products, Inc.

Dual Mode is a trademark of Maxim Integrated Products, Inc.

Features

- ♦ Second-Generation DirectDrive Technology
- ♦ Dynamic, Class H, Dual Mode Charge Pump
- ♦ Low Voltage Operation, V_{PVIN} = 1.8V
- ♦ Low Quiescent Current, 1.15mA (typ) at V_{PVIN} = 1.8V
- ♦ Eliminates Large Output DC-Blocking Capacitors
- ♦ Industry-Leading Click-and-Pop Performance
- ♦ High-Fidelity, SNR 105dB (5.6µV Output Noise)
- ♦ Output Power 34mW into 32Ω (THD+N 1%)
- ♦ Output Power 45mW into 16Ω (THD+N 10%)
- ♦ Tiny, 12-Bump, 1.27mm x 1.65mm (0.4mm Lead Pitch) WLP Package

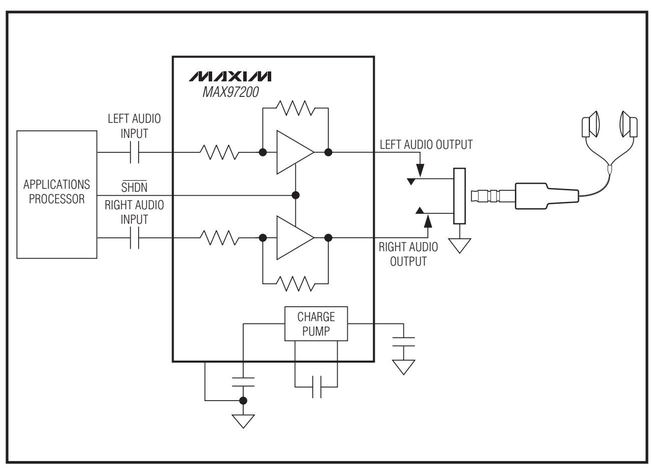
Ordering Information/ Selector Guide

PART	GAIN (dB)	PIN-PACKAGE	TOP MARK
MAX97200AEWC+	3	12 WLP	ABF
MAX97200BEWC+	0	12 WLP	ABG

Note: *All devices operate over the -40°C to +85°C temperature range.*

+Denotes a lead(Pb)-free and RoHS-compliant package.

Typical Operating Circuit



For pricing, delivery, and ordering information, please contact Maxim Direct at 1-888-629-4642, or visit Maxim's website at www.maxim-ic.com.

Low-Power, Low-Offset, Dual Mode, Class H DirectDrive Headphone Amplifier

ABSOLUTE MAXIMUM RATINGS

PVIN or PVDD to PGND ....-0.3V to +2.2V
GND to PGND ....-0.3V to +0.3V
PVSS to PGND ....-2.2V to +0.3V
OUT_ and IN_ to GND .... (PVSS - 0.2V) to (PVDD + 0.2V)
C1P, C1N ....Cap connection only
$\overline{SHDN}$ to GND ....-0.3V to +4V
Output Short-Circuit Current ....Continuous
Thermal Limits (Note 1)
Multiple Layer PCB
Continuous Power Dissipation (T_A = +70°C)
12-Bump WLP (derate 13.7mW/°C above +70°C)....1095mW
12-Bump WLP θ_{JA}...73°C/W
12-Bump WLP θ_{CA}..30°C/W
Junction Temperature ....+150°C
Operating Temperature Range.......................... -40°C to +85°C
Storage Temperature Range........................... -65°C to +150°C
Bump Temperature (soldering) Reflow..........................+230°C

Note 1: Package thermal resistances were obtained using the method described in JEDEC specification JESD51-7, using a four-layer board. For detailed information on package thermal considerations, refer to **www.maxim-ic.com/thermal-tutorial**.

Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

ELECTRICAL CHARACTERISTICS

(V_{PVIN} = 1.8V, V_{PGND} = V_{GND} = 0V, $V_{\overline{SHDN}}$ = 1.8V, C1 = C2 = C3 = 1µF, C4 = 10µF, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at T_A = +25°C.) (Note 2)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
POWER SUPPLY						
Supply Voltage Range	PVIN	Guaranteed by PSRR	1.62	1.80	1.98	V
UVLO Rising				1.48	1.58	V
UVLO Falling			1.36	1.46		V
Quiescent Supply Current	I_{DD}	Inputs grounded, T_A = +25°C, no load		1.15	1.7	mA
		16Ω load, inputs grounded, T_A = +25°C		1.16		
Shutdown Current	$I_{\overline{SHDN}}$	$V_{\overline{SHDN}}$ = 0V, T_A = +25°C		0.2		µA
Turn-On Time	t_{ON}			.6	1	ms
CHARGE PUMP						
Oscillator Frequency	f_{OSC1}	V_{OUT} = 0V, T_A = +25°C	78	83	88	kHz
Oscillator Frequency	f_{OSC2}	V_{OUT} = 0.2V, R_L = ∞, f_{IN} = 1kHz		665		kHz
Oscillator Frequency	f_{OSC3}	V_{OUT} = 0.5V, R_L = ∞, f_{IN} = 1kHz		500		kHz
Positive Output Voltage	V_{PVDD}	V_{OUT} = 0.2V, R_L = ∞		PVIN/2		V
		V_{OUT} = 0.5V, R_L = ∞		PVIN		
Negative Output Voltage	V_{PVSS}	V_{OUT} = 0.2V, R_L = ∞		-PVIN/2		V
		V_{OUT} = 0.5V, R_L = ∞		-PVIN		
Output Voltage Threshold	V_{TH1}	R_L = ∞, output voltage at which the charge pump switches modes, V_{OUT} rising, transition from 1/8 to normal frequency		±PVIN x 0.08		V
Output Voltage Threshold	V_{TH2}	R_L = ∞, output voltage at which the charge pump switches modes, V_{OUT} rising, transition from high-efficiency mode to high-power mode		±PVIN x 0.24		V

ELECTRICAL CHARACTERISTICS (continued)

(V_{PVIN} = 1.8V, V_{PGND} = V_{GND} = 0V, $V_{\overline{SHDN}}$ = 1.8V, C1 = C2 = C3 = 1µF, C4 = 10µF, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at T_A = +25°C) (Note 2)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
Charge-Pump Mode Transition Timeouts (Figure 2)	t_{HOLD}	Time it takes for the charge pump to transition from high-power mode to high-efficiency mode; $R_L = \infty$			32		ms
	t_{RISE}	Time it takes for the charge pump to transition from high-efficiency mode to high-power mode (90% of its value); $R_L = \infty$			20		µs
AMPLIFIER							
Voltage Gain	A_V	MAX97200A		2.75	2.92	3.09	dB
		MAX97200B		-0.17	0	+0.17	
Maximum Output Voltage		R_L = 10kΩ, THD+N = 1%			1.295		V_{PK}
		R_L = 10kΩ, THD+N = 10%			1.44		
Channel-to-Channel Gain Matching					±0.1		dB
Total Output Offset Voltage	V_{OS}	T_A = +25°C			±0.1	±0.3	mV
Input Resistance	R_{IN}	MAX97200A		6	10	14	kΩ
		MAX97200B		7.2	12	16.8	
Power-Supply Rejection Ratio	PSRR	V_{PVDD} = 1.62V to 1.98V, T_A = +25°C		62	83		dB
		100mV_{P-P} ripple	f_{IN} = 217Hz		96		
			f_{IN} = 1kHz		94		
			f_{IN} = 20kHz		61		
Output Power	P_{OUT}	THD+N = 1%	R_L = 10kΩ		0.16		mW
			R_L = 32Ω		34		
			R_L = 16Ω		45		
Line Output Voltage	V_{LINE}	R_L = 10kΩ			1		V_{RMS}
Total Harmonic Distortion Plus Noise	THD+N	R_L = 16Ω, P_{OUT} = 0.1mW, f_{IN} = 1kHz (Note 3)			0.02		%
		R_L = 16Ω, P_{OUT} = 10mW, f_{IN} = 1kHz (Note 4)			0.003		
		R_L = 10kΩ, V_{OUT} = 1V, f_{IN} = 1kHz (Note 4)			0.008		
Output Noise	V_N	Inputs grounded, A-weighted, MAX97200B			5.6		µV
Signal-to-Noise Ratio	SNR	A-weighted, MAX97200B			105		dB
Click-and-Pop Level	V_{CP}	R_L = 32Ω, peak voltage, A-weighted, 32 samples/second, MAX97200B	Into shutdown		80		dBV
			Out of shutdown		68		
Crosstalk	X_{TALK}	R_L = 16Ω, 1kHz, P_{OUT} = 5mW			69		dB
Maximum Capacitive Load					200		pF

Low-Power, Low-Offset, Dual Mode, Class H DirectDrive Headphone Amplifier

ELECTRICAL CHARACTERISTICS (continued)

(V_{PVIN} = 1.8V, V_{PGND} = V_{GND} = 0V, $V_{\overline{SHDN}}$ = 1.8V, C1 = C2 = C3 = 1µF, C4 = 10µF, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at T_A = +25°C) (Note 2)

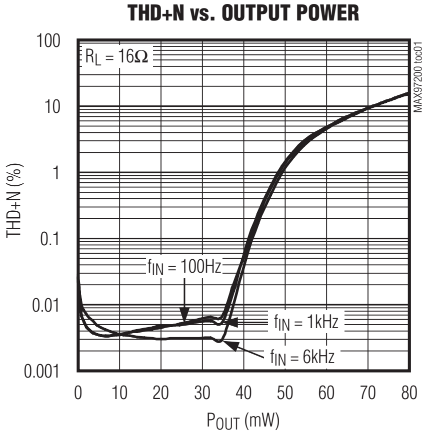
PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
DIGITAL INPUT ($\overline{SHDN}$)						
Input High Voltage	V_{IH}		1.4			V
Input Low Voltage	V_{IL}				0.4	V
Input Leakage Current	I_{IH}	$V_{\overline{SHDN}}$ = 4V, T_A = +25°C	-1		+1	µA
		$V_{\overline{SHDN}}$ = 1.8V, T_A = +25°C	-1		+1	
	I_{IL}	$V_{\overline{SHDN}}$ = 0V, T_A = +25°C	-1		+1	

Note 2: All specifications are 100% tested at T_A = +25°C. Temperature limits are guaranteed by design.
Note 3: V_{PVDD} = 0.9V, V_{PVSS} = -0.9V.
Note 4: V_{PVDD} = 1.8V, V_{PVSS} = -1.8V.

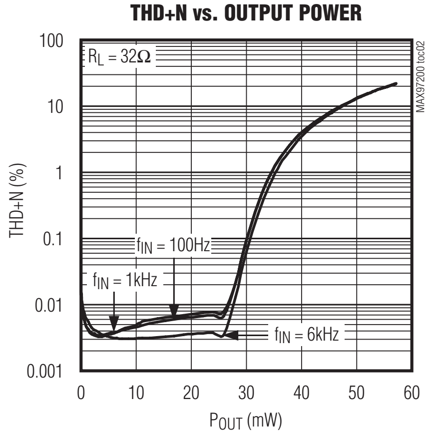
Typical Operating Characteristics

(V_{PVIN} = 1.8V, V_{PGND} = V_{GND} = 0V, $V_{\overline{SHDN}}$ = 1.8V, C1 = C2 = C3 = 1µF, C4 = 10µF, both channels driven in phase, T_A = +25°C, unless otherwise noted.)

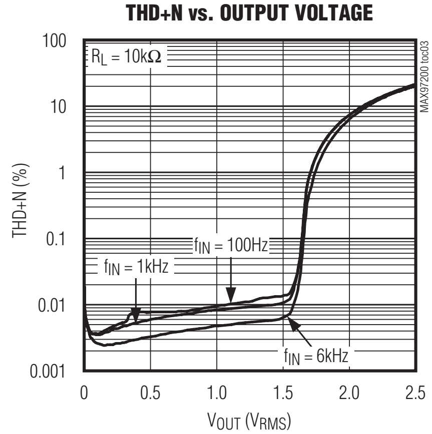
THD+N vs. OUTPUT POWER



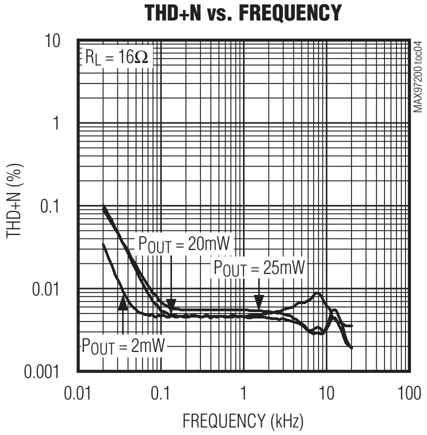
THD+N vs. OUTPUT POWER



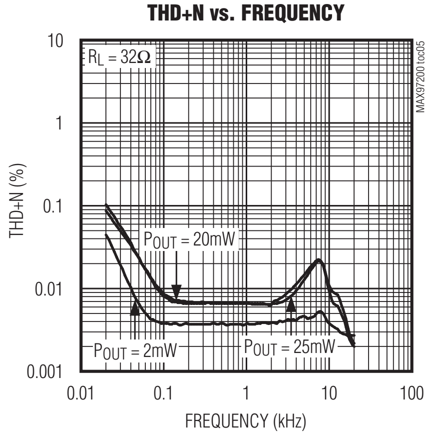
THD+N vs. OUTPUT VOLTAGE



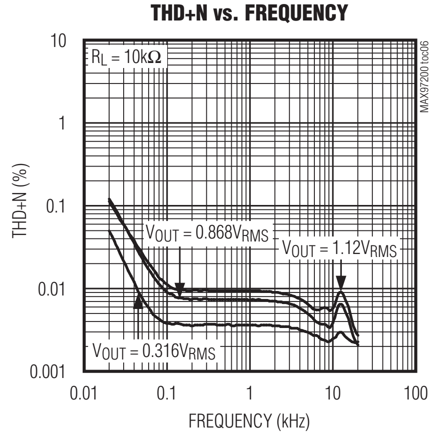
THD+N vs. FREQUENCY



THD+N vs. FREQUENCY



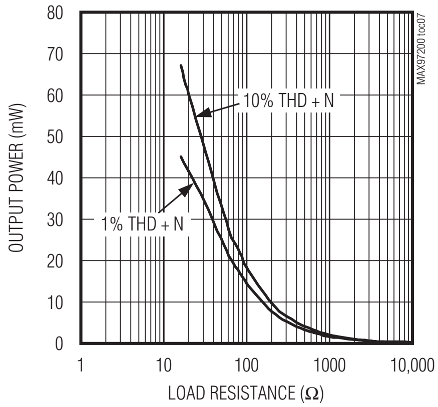
THD+N vs. FREQUENCY



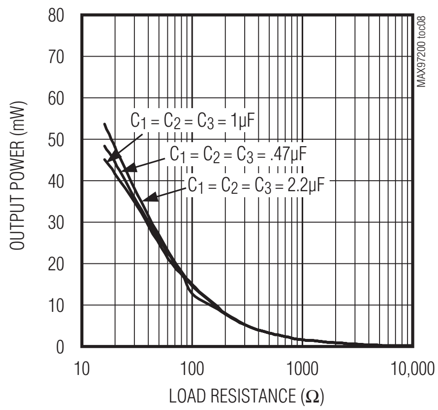
Typical Operating Characteristics (continued)

(V_{PVIN} = 1.8V, V_{PGND} = V_{GND} = 0V, $V_{\overline{SHDN}}$ = 1.8V, C1 = C2 = C3 = 1µF, C4 = 10µF, both channels driven in phase, T_A = +25°C, unless otherwise noted.)

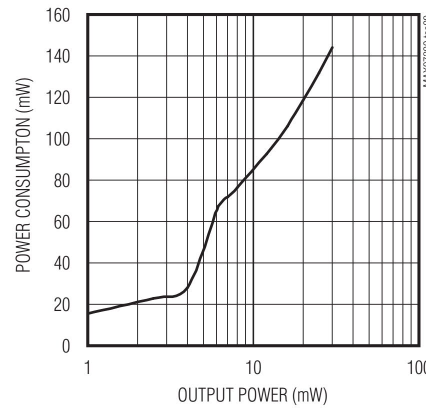
OUTPUT POWER vs. LOAD RESISTANCE



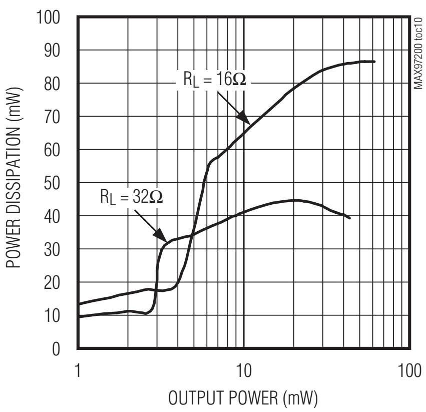
OUTPUT POWER vs. LOAD RESISTANCE AND CHARGE-PUMP CAPACITOR



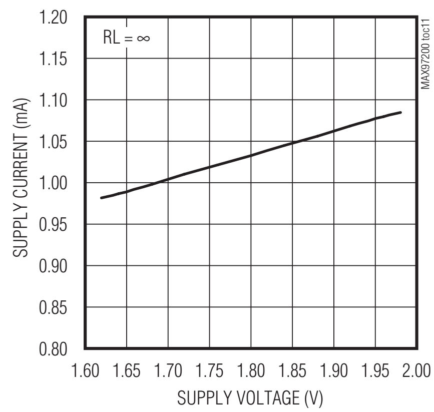
POWER CONSUMPTION vs. OUTPUT POWER



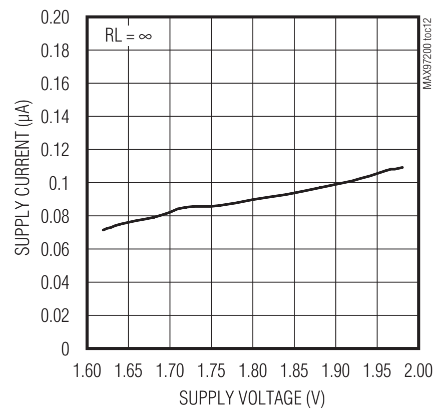
POWER DISSIPATION vs. OUTPUT POWER



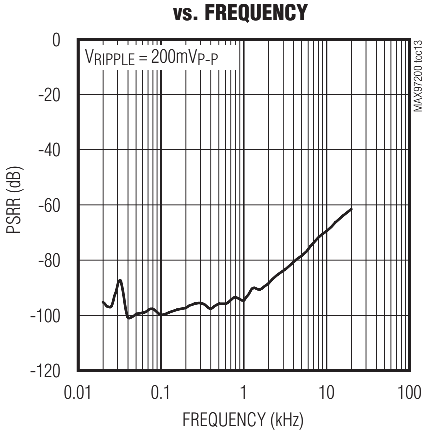
SUPPLY CURRENT vs. SUPPLY VOLTAGE



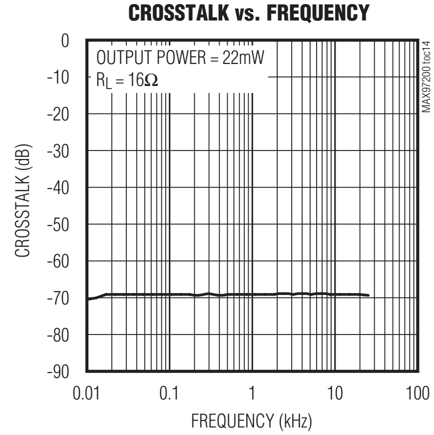
SHUTDOWN SUPPLY CURRENT vs. SUPPLY VOLTAGE



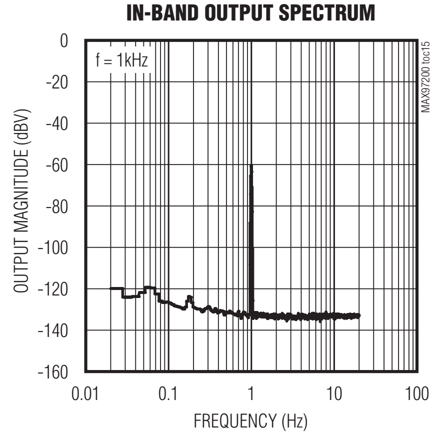
POWER-SUPPLY REJECTION RATIO vs. FREQUENCY



CROSSTALK vs. FREQUENCY



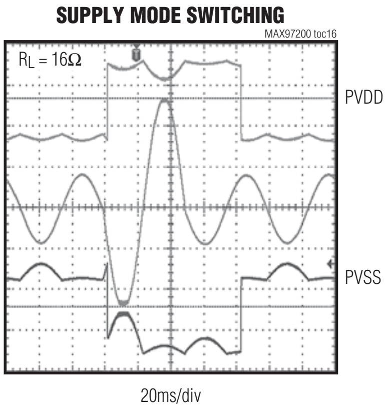
IN-BAND OUTPUT SPECTRUM

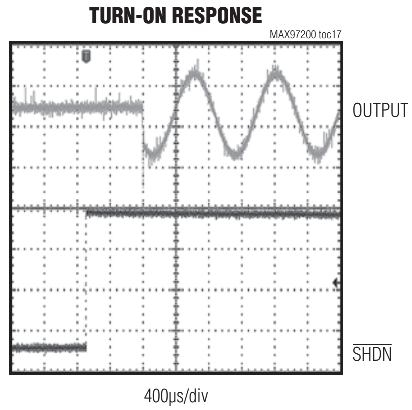


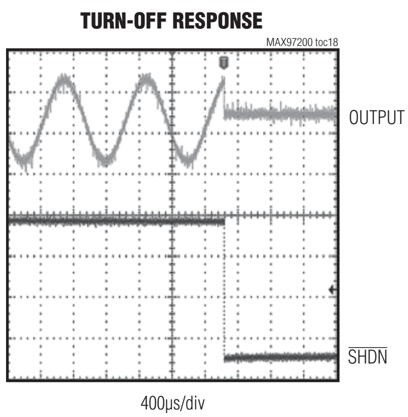
Low-Power, Low-Offset, Dual Mode, Class H DirectDrive Headphone Amplifier

Typical Operating Characteristics (continued)

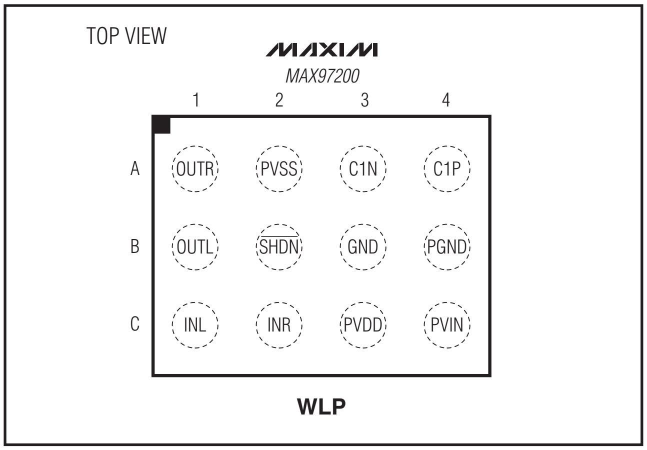
(V_{PVIN} = 1.8V, V_{PGND} = V_{GND} = 0V, $V_{\overline{SHDN}}$ = 1.8V, C1 = C2 = C3 = 1µF, C4 = 10µF, both channels driven in phase, T_A = +25°C, unless otherwise noted.)







Pin Configuration



Pin Description

BUMP	NAME	FUNCTION
A1	OUTR	Right Amplifier Output
A2	PVSS	Negative Charge-Pump Output. Connect a 1µF capacitor between PVSS and PGND.
A3	C1N	Charge-Pump Flying Cap Negative Connection. Connect 1µF capacitor between C1N and C1P.
A4	C1P	Charge-Pump Flying Cap Positive Connection. Connect 1µF capacitor between C1P and C1N.
B1	OUTL	Left Amplifier Output
B2	$\overline{\text{SHDN}}$	Active-Low Shutdown
B3	GND	Signal Ground. Connect to PGND.
B4	PGND	Power Ground. Connect to GND.
C1	INL	Left Audio Input
C2	INR	Right Audio Input
C3	PVDD	Positive Charge-Pump Output. Bypass to PGND with 1µF.
C4	PVIN	Main Power-Supply Connection. Bypass to PGND with 10µF.

Low-Power, Low-Offset, Dual Mode, Class H DirectDrive Headphone Amplifier

Detailed Description

The MAX97200 is a 45mW Class H headphone amplifier that runs from a single low 1.8V supply voltage and employs Maxim's second-generation DirectDrive technology.

Maxim's patented DirectDrive architecture uses an inverting charge pump to derive a negative voltage supply. The headphone amplifier is powered between the positive supply and the generated negative rail. This scheme allows the audio output signal to be biased about ground, eliminating the need for large DC blocking capacitors between the amplifier output and the headphone load.

Second-generation DirectDrive technology improves power consumption when compared to first-generation DirectDrive amplifiers. The MAX97200 can be powered from a regulated 1.8V supply and have similar power consumption to a traditional DirectDrive amplifier that is powered from 0.9V.

The MAX97200 features a dual-mode internal charge pump to generate the power rails for the DirectDrive amplifier. The charge-pump output can be ±PVIN/2 or ±PVIN depending on the amplitude of the output signal. When the output voltage is low the power-supply voltage is ±PVIN/2. When the output signal demands larger output voltage, the charge pump switches modes so that a greater power-supply voltage is realized and more output power can be delivered to the load.

DirectDrive Headphone Amplifier

Traditional single-supply headphone amplifiers have outputs biased at a nominal DC voltage (typically half the supply). Large coupling capacitors are needed to block this DC bias from the headphone. Without these capacitors, a significant amount of DC current flows to the headphone, resulting in unnecessary power dissipation and possible damage to both headphone and headphone amplifier.

Maxim's second-generation DirectDrive architecture uses a charge pump to create an internal negative supply voltage. This allows the headphone outputs of the MAX97200 to be biased at GND while operating from a single supply (Figure 1). Without a DC component, there is no need for the large DC-blocking capacitors. Instead of two large (220µF typ) capacitors, the MAX97200 charge pump requires 3 small ceramic capacitors, conserving board space, reducing cost, and improving the frequency response of the headphone amplifier.

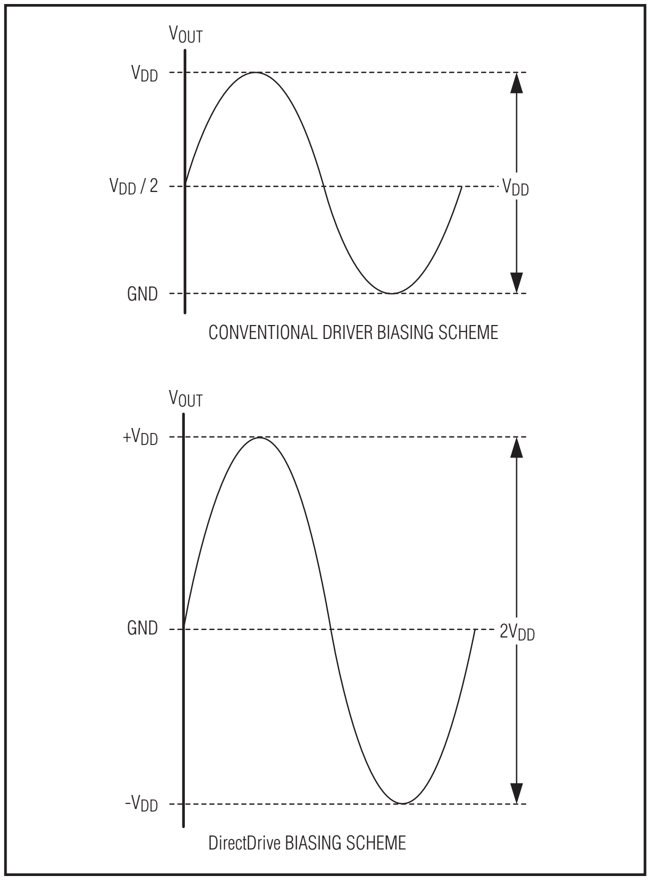


Figure 1. Traditional Amplifier vs. MAX97200 DirectDrive Output

Dual Mode Charge Pump

The MAX97200's Dual Mode, charge pump outputs either ±PVIN/2 in high-efficiency mode or ±PVIN in high-power mode, resulting in a power-supply differential of 1.8V or 3.6V. The charge-pump mode changes based on the level of the output signal needed. When the output voltage is small, the voltage rails are reduced to minimize power consumption. When the output voltage is large, the voltage rails are increased to accommodate the larger output need.

High-power mode is similar to Maxim's traditional DirectDrive architecture and is best suited for loads that require high voltage swing. High-efficiency mode improves power consumption by reducing the power-supply voltage across the amplifier's output stage by half. The reduced power-supply voltage is good for idle conditions or low-signal level conditions into a headphone.

Class H Operation

The MAX97200's internal Class H amplifier uses a class AB output stage with multiple, discreet power supplies. This result's in two power-supply differentials of 1.8V and 3.6V generated from a single 1.8V external supply. The PVIN/2 power-supply differential is used when the output voltage requirements are low, and the output is below V_{TH2} as seen in Figure 2. The higher supply differential is used when the output voltage exceeds the high threshold V_{TH2}, maximizing output power and voltage swing. The transition time from high-efficiency mode to high-power mode occurs when the threshold is crossed.

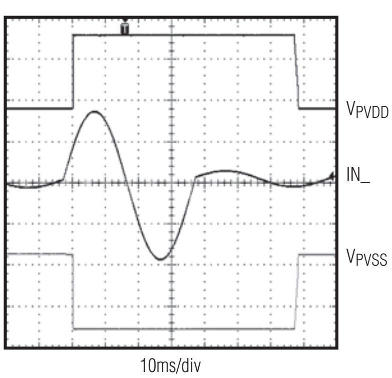


Figure 2. Inverting and Split Mode Transitions

The switch from high-power mode to high-efficiency mode occurs 32ms (typ) after the threshold is crossed. Built-in hysteresis keeps the charge pump from erratic mode switching when the output voltage is near the high and low thresholds.

Click-and-Pop Suppression

In conventional single-supply audio amplifiers, the output-coupling capacitor contributes significantly to audible clicks and pops. Upon startup, the amplifier charges the coupling capacitor to its bias voltage, typically half the supply. Likewise, on shutdown, the capacitor is discharged. This results in a DC shift across the capacitor, which appears as an audible transient at the speaker. Since the MAX97200 does not require output coupling capacitors, this problem does not arise. Additionally, the MAX97200 features extensive click-and-pop suppression that eliminates any audible transient sources internal to the device.

Typically, the output of the device driving the MAX97200 has a DC bias of half the supply voltage. At startup, the input-coupling capacitor, C_{IN}, is charged to the preamplifier's DC bias voltage through the MAX97200 input resistor, R_{IN}. This DC shift across the capacitor results in an audible click-and-pop. The MAX97200 precharges the input capacitors when power is applied to ensure that no audible clicks or pops are heard when $\overline{SHDN}$ is pulled high.

Shutdown

The MAX97200 features a 1µA, low-power shutdown mode that reduces quiescent current consumption and extends battery life. Shutdown is controlled by the $\overline{SHDN}$ input. Driving the $\overline{SHDN}$ input low disables the drive amplifiers and charge pump and sets the headphone amplifier output resistance to 100Ω.

Applications Information

Component Selection

Input-Coupling Capacitor

The input capacitor (C_{IN}), in conjunction with the amplifier input resistance ($R_{IN\_}$), forms a highpass filter that removes the DC bias from the incoming signal. The AC-coupling capacitor allows the amplifier to bias the signal to an optimum DC level. Assuming zero source impedance, the -3dB point of the highpass filter is given by:

$$f_{-3dB} = \frac{1}{2\pi R_{IN} C_{IN}}$$

R_{IN} is the amplifier's input resistance value. Choose C_{IN} such that f_{-3dB} is well below the lowest frequency of interest. Setting f_{-3dB} too high affects the amplifier's low frequency. Capacitors with higher voltage coefficients, such as ceramics, result in increased distortion at low frequencies.

Charge-Pump Capacitor Selection

Use capacitors with an ESR less than 100mΩ for optimum performance. Low ESR ceramic capacitors minimize the output resistance of the charge pump. For best performance over the extended temperature range, select capacitors with an X7R dielectric.

Flying Capacitor (C1)

The value of the flying capacitor (C1) affects the load regulation and output resistance of the charge pump. A C1 value that is too small degrades the device's ability to provide sufficient current drive, which leads to a loss of output voltage. Connect a 1µF capacitor between C1P and C1N.

Output Capacitors (C2, C3)

The output capacitor value and ESR directly affect the ripple at PVSS. Increasing the value of C2 and C3 reduces output ripple. Likewise, decreasing the ESR of C2 and C3 reduces both ripple and output resistance. Lower capacitance values can be used in systems with low maximum output power levels. Connect a 1µF capacitor between PVDD and PGND. Connect a 1µF capacitor between PVSS and PGND.

RF Susceptibility

Improvements to both layout and component selection can decrease the MAX97200 susceptibility to RF noise and prevent RF signals from being demodulated into audible noise. Trace lengths should be kept below ¼ of the wavelength of the RF frequency of interest. Minimizing the trace lengths prevents the traces from functioning as antennas and coupling RF signals into the MAX97200. The wavelength (λ) in meters is given by:

$$\lambda = c/f$$

where $c = 3 \times 10^8$ m/s, and f is the RF frequency of interest.

Route audio signals to the middle layers of the PCB to allow the ground planes above and below to shield them from RF interference. Ideally, the top and bottom layers of the PCB should primarily be ground planes to create effective shielding.

Additional RF immunity can also be obtained from relying on the self-resonant frequency of capacitors as it exhibits the frequency response similar to a notch filter. Depending on the manufacturer, 10pF to 20pF capacitors typically exhibit self resonance at RF frequencies. These capacitors when placed at the input pins can effectively shunt the RF noise at the inputs of the MAX97200. For these capacitors to be effective, provide a low-impedance, low-inductance path from the capacitors to the ground plane. Do not use microvias to connect to the ground plane as these vias do not conduct well at RF frequencies. Figure 3 shows headphone RF immunity with a well laid out PCB.

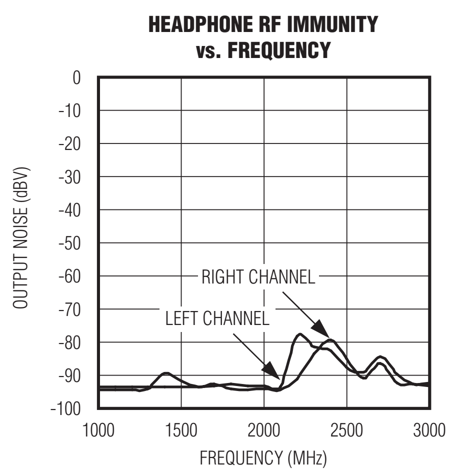


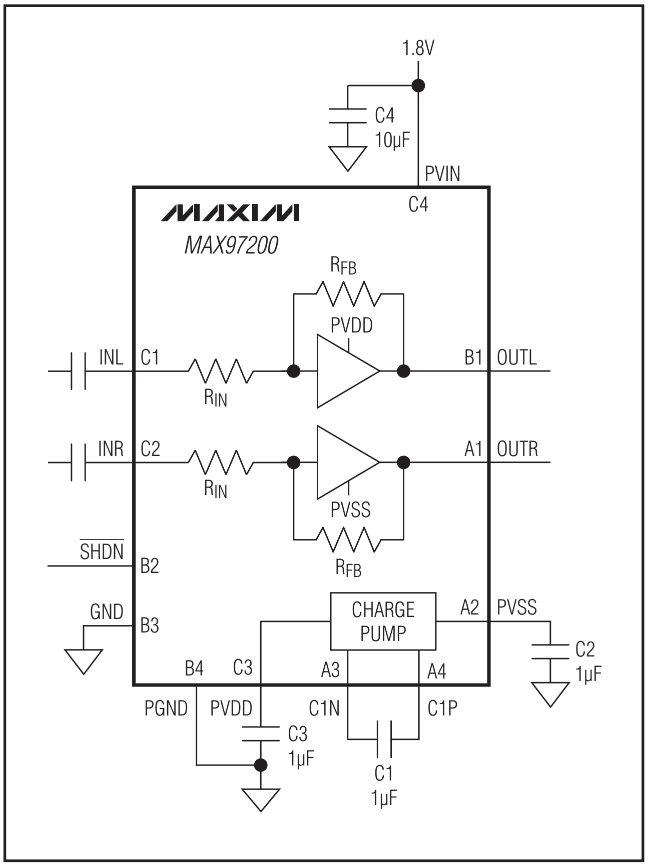
Figure 3. Headphone RF Immunity

Layout and Grounding

Proper layout and grounding are essential for optimum performance. Use large traces for the power-supply inputs and amplifier outputs to minimize losses due to parasitic trace resistance, as well as route heat away from the device. Good grounding improves audio performance, minimizes crosstalk between channels, and prevents switching noise from coupling into the audio signal. Connect PGND and GND together at a single point on the PCB. Route PGND and all traces that carry switching transients away from GND, and the traces and components in the audio signal path.

Connect C2 to the PGND plane. Place the charge-pump capacitors (C1, C2) as close as possible to the device. Bypass PVDD with a 1µF capacitor to PGND. Place the bypass capacitors as close as possible to the device.

Simplified Functional Diagram



Chip Information

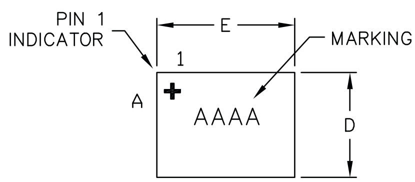
PROCESS: BiCMOS

Low-Power, Low-Offset, Dual Mode, Class H DirectDrive Headphone Amplifier

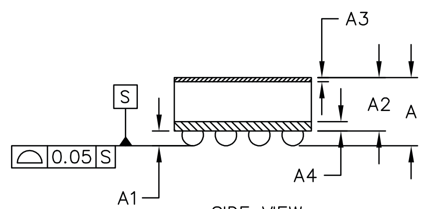
Package Information

For the latest package outline information and land patterns, go to **www.maxim-ic.com/packages**. Note that a "+", "#", or "-" in the package code indicates RoHS status only. Package drawings may show a different suffix character, but the drawing pertains to the package regardless of RoHS status.

PACKAGE TYPE	PACKAGE CODE	DOCUMENT NO.
12-Bump WLP	W121A1+1	21-0449



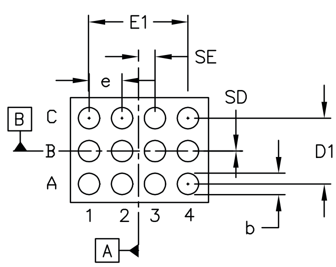
TOP VIEW



SIDE VIEW

COMMON DIMENSIONS	
A	0.64±0.05
A1	0.19±0.03
A2	0.45 REF
A3	0.025 BASIC
A4	0.07 BASIC
b	ø0.27±0.03
D1	0.80 BASIC
E1	1.20 BASIC
e	0.40 BASIC
SD	0.00 BASIC
SE	0.20 BASIC

PKG. CODE	E		D		DEPOPULATED BUMPS
	MIN	MAX	MIN	MAX	
W121A1+1	1.61	1.75	1.23	1.37	NONE



BOTTOM VIEW

NOTES:
1. Terminal pitch is defined by terminal center to center value.
2. Outer dimension is defined by center lines between scribe lines.
3. All dimensions in millimeters.
4. Marking shown is for package orientation reference only.
5. Tolerance is ± 0.02mm unless specified otherwise.
6. All dimensions apply to PbFree (+) package codes only.

MAXIM

TITLE: PACKAGE OUTLINE 12 BUMPS, WLP PKG. 0.4mm PITCH

APPROVAL | DOCUMENT CONTROL NO. 21-0449 | REV. B | 1/1

-DRAWING NOT TO SCALE-

Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	1/10	Initial release	—
1	3/10	Removed shutdown current max value	2